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NASA CR 56891

UNPUBLISHED PRELIMINARY DATA

February 1, 1964

SUBJECT: First Semi-Annual Progress ReportGRANT: N.A.S.A. No. Nsg 410 - Theoretical and Experimental
Investigations of Fatigue Crack GrowthPRINCIPAL INVESTIGATOR: Dr. Paul C. ParisA. Results To Date

The studies of mechanical models of crack growth were formally reported during the Summer of 1963 in a paper:

"The Fracture Mechanics Approach to Fatigue", by Paul C. Paris, presented at the 1963 Sagamore Conference, and to be published in the Proceedings of the Conference, Syracuse University Press, expected in 1964.

Reprints of this paper were sent to N.A.S.A. previously. The work on models of the crack growth process is continuing in direct efforts and also indirectly in some experimental phases of this work.

~~An earlier paper on the controlling laws of crack~~
growth has appeared as:

"A Critical Analysis of Crack Propagation Laws", by Paul C. Paris and Fazil Erdogan, A.S.M.E., The Journal of Basic Engineering, December 1963.

Reprints of this paper are being sent to N.A.S.A. under separate cover.

On the mathematical analysis of characteristics of random loads, work has proceeded on analization of rises and falls for various power spectra. This work is to be published as:

"Some Characteristics of Random Loads Relevant to Fatigue", by James R. Rice, Ferdinand P. Beer and Paul C. Paris, to be presented at the W.A.D.D. Conference on Acoustic Fatigue, April 1964, and published in the Conference Proceedings. Work along this line will be continued in the future and reported in Mr. Rice's Ph.D. thesis, as well as by other means.

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After beginning the project, an interest in statistic aspects of initiation, growth of cracks, and final failure in fatigue has arisen. Some work on this problem is reported in:

A discussion by James R. Rice and Earl J. Brown of "Random Fatigue Failure of a Multiple Load Path Structure", by A. S. Heller, R. A. Heller and A. M. Fruedenthal. Proceeding of the 1963 Sagamore Conference, Syracuse University Press, 1964.

A more complete analysis of this area is being transmitted to N.A.S.A. under separate cover as:

"Some Statistical Aspects of Fatigue Failure Through Crack Propagation", Earl J. Brown and James R. Rice, Lehigh University Institute of Research Report, February 1964.

Work on this area will continue.

Some allied work^{on} analysis of crack bodies is being compiled by the principal investigator for publication as:

"Stress Analysis of Cracked Bodies", by Paul C. Paris and George C. M. Sih, to be presented at the A.S.T.M. Nation Meeting - Conference on Fracture Testing of High Strength Materials, Chicago, June 1964, and to be published in a book on the Conference Proceedings by A.S.T.M.

Reprints of this work will be supplied to N.A.S.A. shortly after March 15, 1964.

In addition to the above studies, for which reports or papers are published or imminent, some other work of longer term to publication has commenced. The most notable are:

- (1) Experiments to Examine the Characteristics of Extremely Slow Growth of Cracks.
- (2) Experimental Analogue Testing of Crack Growth Models.
- (3) The Effect of Stress Conditions on the Fractography of Fatigue Crack Surfaces.

Reports may be expected in these and other areas as progress is made.

B. Communication with the Grant Monitor

The grant monitor and the principal investigator have met and discussed grant business on the following occasions:

- (1) In August 1963 at the Sagamore Conference, Syracuse University.
- (2) In September 1963 at N.A.S.A.'s Langley Research Center.
- (3) In December 1963 at N.A.S.A.'s Langley Research Center.

Similar discussions are planned in March and April 1964 and at later dates. These meetings and several telephone contacts have provided a high degree of communication. Moreover, the cooperation, information supplied and encouragement of Mr. Hardrath and his colleagues is gratefully acknowledged.

In addition, the principal investigator also visited the N.A.S.A. Lewis Research on two occasions last year to exchange the latest results of these and allied studies. The main contacts there have been Mr. William F. Brown and Mr. John Scrawley.

A visit was also made to N.A.S.A. Headquarters in Washington, D.C., in December 1963 during which the grant was discussed with Mr. Jerome Morris.

C. Funding and Duration

[REDACTED]

As originally proposed, extension of the grant for an additional two years (or more) will be requested in a forthcoming proposal.

Paul C. Paris
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Principal Investigator